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PATENT ABSTRACTS OF JAPAN

(11)Publication number : 08-255619
(43)Date of publication of application : 01.10.1996

(51)Int.Cl. H01M 8/02
H01M 8/10

(21)Application number : 07-060765
(22)Date of filing : 20.03.1995

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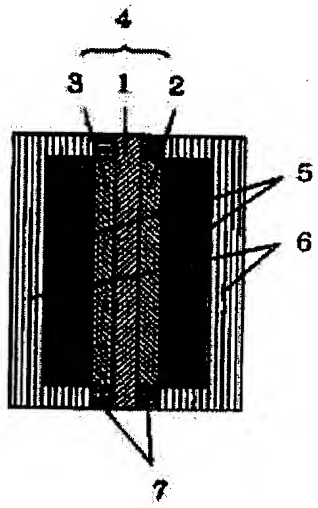
(54) FUEL CELL

(57)Abstract:

PURPOSE: To evenly supply reaction gas to electrodes, and to obtain high performance in the high current density zone by forming a drainage plate, which feeds reaction gas to each electrode of a unit cell, from the three-dimensional network porous carbon.

CONSTITUTION: A positive electrode 2 and a negative electrode 3 are bonded to both sides of a solid polymer electrolyte film 1 so as to form a unit cell 4 of, for example, a hydrogen-oxygen fuel cell. A drainage plate 5 made of porous carbon having three-dimensional network is arranged in both outsides of the unit cell 4, and they are pinched by separators 6 made of gas impermeable glass carbon so as to form a unit cell. At this stage, porosity of the porous carbon having three-dimensional network is set at 50-95%, and a large quantity of reaction gas is supplied to the electrode, and since the drainage plate 5 contacts with the whole of the electrode surface, the reaction gas is evenly supplied so as to improve the cell voltage at a high current density and improve the limit current density. Furthermore, the contact surfaces of the separator 6 and the drainage plate 5 is coated with the conductive coating so as to reduce the internal resistance, and the discharging characteristic is thereby improved.



CLAIMS

[Claim(s)]

[Claim 1]A separator for countering each electrode of a unit cell which has arranged a cathode and an anode, and said unit cell, being allotted to electrolytic both sides, and sending reactant gas to each electrode, A fuel cell which is porous carbon which is arranged in contact with said separator and provided with said unit cell and a separator board which pinches a separator, and in which at least one side of said separator has three-dimensional mesh texture.

[Claim 2]The fuel cell according to claim 1 whose voidage of porous carbon which has three-dimensional mesh texture is 50 to 95%.

[Claim 3]The fuel cell according to claim 1 in which a water-repellent finish according [porous carbon which has three-dimensional mesh texture] to a fluoro-resin is given, and the amount of fluoro-resins is 60 or less weight %.

[Claim 4]The fuel cell according to claim 1 which applied a conductive paint to a touching field of a separator board and porous carbon which has three-dimensional mesh texture.

[Claim 5]The fuel cell according to claim 1 with which a conductive liner sheet was arranged between a separator board and porous carbon which has three-dimensional mesh texture.

[Claim 6]The fuel cell according to claim 1 whose electrolyte is a solid polymer electrolyte.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application]This invention relates to the separator for supply of the reactant gas of the fuel cell using air and oxygen as an oxidizer, especially a polymer electrolyte fuel cell, using the modified water matter from pure water matter or methanol, and a fossil fuel, etc. as a reducing agent.

[0002]

[Description of the Prior Art]The polymer electrolyte fuel cell uses the ion-exchange

membrane for the electrolyte, and the following reactions occur in the anode which makes hydrogen fuel gas.

[0003]

[Chemical formula 1]

$$H_2 \rightarrow 2H^+ + 2e^-$$

[0004] With the cathode which uses oxygen as an oxidizer, it is [0005].

[Chemical formula 2]

$$\frac{1}{2}O_2 + 2H^+ + 2e^- \rightarrow H_2O$$

[0006] ****** occurs and water is generated. In a polymer electrolyte fuel cell, since ion conductivity is not shown unless the ion-exchange membrane which is an electrolyte is a moisture state, it is necessary to humidify reactant gas at a temperature higher than cell temperature. As a result, in order for the concentration of reactant gas to fall and to make high power possible with a steam, a lot of gas supply to the reaction site inside an electrode and an electrode catalyst layer, i.e., the improvement in gas supply ability, is needed.

[0007]Among these, in order to raise the gas supply ability to an electrode, the separator which is a structural material of a cell serves as weight. While a separator is a charge collector, it must have a function which supplies reactant gas uniformly to an electrode plane, and discharges excessive humidifying water and produced water promptly. Therefore, although it is desirable that it is the material of the porosity which has conductivity as for a separator, in order to simplify structure of a layer built cell, For example, in JP,H5-251097,A, the gas passage groove 10 is established in electrode 2 and 3 side by a rib using the ribbed separator 9 which consists of metal, such as carbon or titanium, as shown in drawing 3, and the width is made large in the lower stream. On the other hand, in JP,H6-168728,A, it is considered as the separator which contacted the flat-surface side where a rib does not exist in one side using the porous carbon board which has a rib to the catalyst bed, and served as the gas diffusion layer. And the reactant gas passing through the inside of a rib was made to penetrate in porosity, and the catalyst bed was made to reach. Furthermore by JP,H3-205763,A, the gas passage groove winding in the separator is provided.

[0008]

[Problem to be solved by the invention]However, in the method of using the above-mentioned ribbed separator 9, it had the fault that gas is not supplied to the

portion which an electrode and a rib touch since a separator is gas impermeability, gas was supplied only in a rib, and supply of the gas to an electrode became uneven. In the case where the porous carbon with a rib which served as the gas diffusion layer generally known is used as a structure of a phosphoric acid fuel cell. In order to keep intensity good, thickness of the flat part in which the rib of a porous carbon board does not exist needed to be enlarged, into the porosity of this flat part, it took time to make reactant gas penetrate, and the battery characteristic was falling. The gas supply ability to the catalyst bed had to be raised to realize high power density in ordinary pressure. In the still more above ribbed separators or porous carbon with a rib, processing for providing a gas passage groove or a metallic mold was required. When the winding gas passage groove was established in the separator, pressure loss was large, and since gas would not flow if complicated processing is required and also there is not sufficient pressure differential for an outlet side the entrance side of gas, it had the fault that several atmospheres or more had to be pressurized.

[0009]This invention solves the above-mentioned conventional problem, its voidage is high, and it aims at providing a more highly efficient solid polyelectrolyte type fuel cell by using processing for the separator as for which **** is not.

[0010]

[Means for solving problem]The unit cell which has arranged the cathode and the anode to electrolytic both sides in order to attain this purpose, In a fuel cell provided with the separator which counters each electrode of said unit cell, is arranged, and sends reactant gas to each electrode, and the separator board which is arranged in contact with said separator and pinches said unit cell and a separator, At least one separator consists of three-dimensional reticulated porous carbon, and makes voidage 50 to 95% preferably. The three-dimensional reticulated porous carbon given a water-repellent finish with 60 or less weight % of the fluoro-resin is used at least for one side of a separator. A conductive paint is considered as spreading or the composition which pinches a conductive liner sheet between a separator and a separator in the field where at least one separator and separator furthermore touch.

[0011]

[Function]In this composition, since there is no blinding by superfluous humidifying water and produced water, and uniform and high gas supply ability to an electrode is realized and a current is collected in the whole electrode plane, internal resistance can be reduced, and a high power fuel cell can be provided. Internal resistance can be further reduced by pinching a conductive liner sheet for a conductive paint between spreading or a separator, and a separator to the field which touches the separator of a

separator. Since there is **** about the processing metallurgy type in which a separator is still more complicated as for nothing, an inexpensive fuel cell can be provided.

[0012]

[Working example]Hereafter, the working example of this invention is described, referring to Drawings.

[0013](Working example 1) Drawing 1 shows the sectional view of the cell of the working example of this invention.

[0014]solid polyelectrolyte membrane (the product made by U.S. Du Pont.) the separator 5 (U.S. Energy Research andGeneration and the product made by Inc.) which becomes the outside of the unit cell 4 which joined the cathode 2 and the anode 3 to the both sides of Nafion1171 from the porous carbon which has three-dimensional mesh texture Duocel, RVC-100PPI, and the 3 time compression article have been arranged, it put with the separator 6 which consists of gas-impermeable glassy carbon, and the cell A was produced. The outline view of three-dimensional reticulated porous carbon is shown in drawing 4. The spark test of this cell A was used for fuel, oxygen was used for hydrogen and an oxidizer, and it carried out with atmospheric pressure and the cell temperature of 50 **.

[0015](Working example 2) Except having used for the separator 5 the three-dimensional reticulated porous carbon covered with 30weight % of polytetrafluoroethylene (henceforth referred to as PTFE), it is completely the same as (the working example 1), this was made into the cell B, and the same spark test as (the working example 1) was done.

[0016](Working example 3) Drawing 2 shows the sectional view of another cell of this example. Except having applied the conductive paint (Daikin Industries, LTD., poly fronter FUKOTO enamel) 8 which consists of carbon and a fluoro-resin to the field which touches the separator 5 of the separator 6, it is completely the same as (the working example 1), this was made into the cell C, and the same spark test as (the working example 1) was done.

[0017](Working example 4) Except having pinched the conductive liner sheet 8 (GRAFOIL by U.S. UNION CARBIDE) which consists of black lead between the separator 5 and the separator 6, it is completely the same as (the working example 1), this was made into the cell D, and the same spark test as (the working example 1) was done.

[0018](Comparative example) Drawing 3 shows the sectional view of the cell of the comparative example of this invention. Except having used the ribbed separator 9

which turns into a separator and a separator from gas-impermeable glassy carbon, it is completely the same as (the working example 1), this was made into the cell E, and the same spark test as (the working example 1) was done.

[0019]The current-voltage curve of the cell E of the cell A, B, and C of the working example of this invention, D, and a comparative example was shown in drawing 5. In the cell A, B, and C of this example, and D, the cell voltage in 1.0 A/cm^2 showed 0.52V, 0.52V, 0.55V and 0.565V, and a high value to the cell E of a comparative example being 0.44V, respectively. Furthermore, as for the cell A, B, and C of the working example of this invention, and D, 1.4A/cm^2, 1.6A/cm^2, 1.45A/cm^2 and 1.45 A/cm^2, and a large value were shown to the cell E of limiting current density of a comparative example being 1.2A/cm^2, respectively. The cell A, B, and C of this example and D were reduced with 7.8mohm, 8.0mohm, 6.9mohm, and 6.9-mohm to the cell E of internal resistance of a comparative example being 9.0mohm, respectively.

[0020]The voidage of the separator used for this example is 80% 92% in the cell A, C, and D at the cell B. Therefore, when the three-dimensional mesh shape porous carbon of this example was used, a lot of reactant gas was supplied to the electrode, in order that there might be no rib processing further and a separator might contact the whole electrode area, reactant gas was supplied uniformly, and the cell voltage and limiting current density in high current density improved. Although the separator of the cell B has voidage smaller than the separator of other working examples, the thing with large limiting current density is because blinding by water becomes difficult to take place by water-repellent finish by a fluoro-resin and supply of reactant gas was performed more smoothly. Although voidage used 80% and 92% of three-dimensional reticulated porous carbon in this example, the same effect was acquired in that whose voidage is 50 to 95%. Although PTFE was used as a repellent in this example, the same effect was acquired when it was a fluoro-resin which has water repellence, such as other fluoro-resins, for example, an ethylene tetrafluoride 6 fluoridation propylene copolymer, and perfluoroalkyl vinyl ether. Although the amount of fluoro-resins was furthermore made into 30 weight % by this example, the same effect was acquired at 60 or less weight %.

[0021]In order that the separator of a comparative example might collect a current with a rib, the touch area with an electrode was a half grade of an electrode area, but the separator of this example did not have a rib, and in order to contact and collect a current to the whole electrode plane, it enabled the internal resistance of the cell to decrease. Furthermore, by applying a conductive paint to the field where a separator and a separator touch, or pinching a conductive liner sheet between a separator and

separators, by reducing contact resistance, internal resistance was decreased and the discharge characteristic improved by the cells C and D of this example. The same effect will be acquired if it is a conductive paint which has corrosion resistance besides having used for this example. Although the black lead sheet was used as a conductive liner sheet in this example, the same effect will be acquired if it is a sheet which consists of a conductive material which has corrosion resistance.

[0022]Although the hydrogen-oxygen fuel cell which used solid polyelectrolyte membrane as an electrolyte as an example of a fuel cell was furthermore taken up by this example, The fuel cell using the modified water matter which uses methanol, natural gas, naphtha, etc. as fuel, Or it is effective, even if it is also possible to apply to the fuel cell using air as an oxidizer and it applies to acid electrolytes, such as alkali electrolytes, such as sodium hydroxide and a potassium hydrate, phosphoric acid, sulfuric acid, and carbonic acid fused salt, and the fuel cell using the solid oxide electrolyte etc. further as an electrolyte.

[0023]

[Effect of the Invention]a separator contacting and collecting a current to the whole electrode plane, and reducing internal resistance, when this invention uses three-dimensional reticulated porous carbon for a separator in a fuel cell in [effect-of-the-invention this invention obtaining -- further -- a separator.

Therefore, by carrying out, there is no blinding by produced water, uniform and high gas supply ability to an electrode is realized, and it is ****** about a high power fuel cell.

Internal resistance can be reduced by pinching a conductive liner sheet for a conductive paint between spreading or a separator, and a separator to the field which touches the separator of a separator. Since there is **** about the processing metallurgy type in which a separator is still more complicated as for nothing, an inexpensive fuel cell can be provided.